otis. (F. N.)

THE

"PERFECTED EVACUATOR"

BY

FESSENDEN N. OTIS, M. D.

CLINICAL PROFESSOR OF GENITO-URINARY DISEASES IN THE COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK; CONSULTING SURGEON TO CHARITY HOSPITAL, TO NEW YORK SKIN AND CANCER HOSPITAL, TO ST. ELIZABETH'S HOSPITAL, TO THE MANHATTAN EYE AND EAR HOSPITAL, ETC.

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THE "PERFECTED EVACUATOR."

THE credit of conceiving and carrying to ultimate success the operation of removing stone from the bladder by lithotrity at a single sitting is indisputably due to Professor Henry J. Bigelow, of Boston.

The method of crushing the stone has not materially changed from that pursued in former times, although we are indebted also to Dr. Bigelow for more powerful lithotrites. These at once became a necessity when attacking the large and hard stones, which the field of his brilliant operation quickly embraced. With the heavier instruments now available, it is rare indeed to find a stone which, in skilled hands, is beyond their compass. After the ability to use large evacuating tubes (from 25 mm. to 30 mm. in circumference, and even larger) was demonstrated, the evacuation of the *débris* seemed easy of accomplishment. The first instrument (a modification of Clover's) devised by Professor Bigelow answered the purpose admirably in the main, but was soon found to permit a return to the bladder of a portion of the *débris* after it had been deposited in the receiver, a fault which, however, did not prevent the accomplishment of many notable successes by this method; but Professor Bigelow at once began a series of elaborate and expensive experiments to remove the difficulty. Sir Henry Thomp-

son, of London, who soon adopted Professor Bigelow's operation and contrived instruments of his own for its accomplishment, found the same difficulty to contend with. A sharp rivalry between these distinguished surgeons—to construct an evacuator which should act by the most direct and shortest route, and yet perfectly prevent the return of *débris* to the bladder—began in 1879, and for the several succeeding years furnished to the journals (chiefly the London "Lancet") many interesting illustrations and much animated discussion. After various modifications and expedients had been adopted and discarded during a period of several years, Professor Bigelow, in 1883, presented the instrument which has remained from that time up to the present (1889) without modification.

In presenting this improved instrument to the profession, in the London "Lancet," January 6, 1883, Professor Bigelow says:

"However otherwise arranged, a satisfactory aspirator should have some device near the catheter to act as a trap or *débris* and secure every fragment that has passed it. The chief difference among evacuators now is in the certainty with which they retain the fragments they have aspirated. Any instrument will draw out the fragments, but few hold them securely, for the *débris* does not always fall into the glass receiver, nor does it always remain in it. On the contrary, it is easily carried back into the bladder. This defect in the action of the evacuator has received little attention from surgeons, although it is the only point connected with the instrument which offers any difficulty whatever. Until recently it has been remedied only by sacrificing simplicity in the apparatus."

In this latest instrument of Professor Bigelow the route to the bladder has been changed to correspond with that of Sir Henry Thompson, in which the evacuating tube was

attached directly to the evacuator, without the intervention of tubing, as in Professor Bigelow's previous instruments, thus apparently giving both surgeons the advantage of the

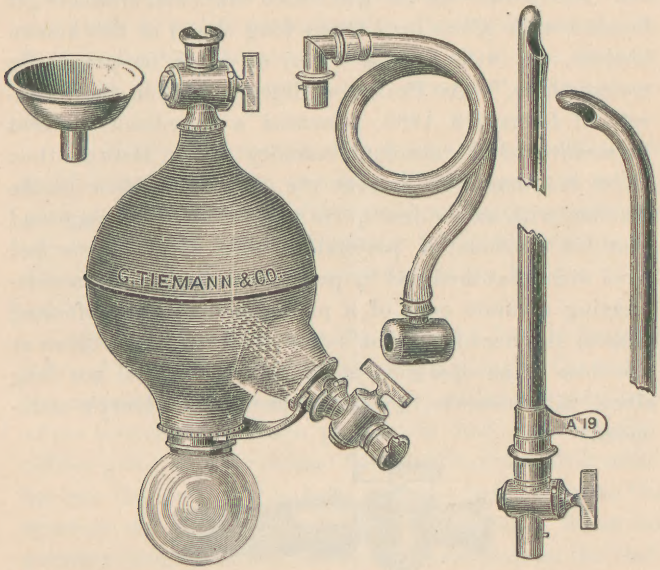

FIG. 1.—Professor Bigelow's latest evacuator. Weighs twenty-four ounces; filled, weighs thirty-four and a half ounces; holds ten and a half ounces.

same and the shortest route to the bladder. In place of various contrivances—ball, valves, traps, and strainer of previous modifications—a perforated tube was inserted into the lower side of the rubber bulb and continuous with a stop-cock which connected directly with the evacuating catheter. This perforated tube or strainer was alleged to prevent effectually the return of *débris* into the bladder, and, in operation, it was proved to do so; but the strainer, while working perfectly in experiments with crushed coal or coral, when in practical use quickly became so clogged

with mucus and coagulated blood that the frequent cleansing of the strainer during operation became necessary. This fact led Sir Henry Thompson to say (London "Lancet," 1883) that "all the perforated tubes and strainers get blocked with *débris* (as I found long since) in the human bladder, not with coal in water, so as to be practically useless there." As Professor Bigelow had, in the "Lancet" of January 6, 1883, presented a large-sized woodcut illustrative of the absolute inability of Sir Henry's then latest instrument to prevent the return of *débris* to the bladder, with ample descriptive text, it might be suggested that his opinions of perforated tubes and strainers had been somewhat modified by personal feeling. The accompanying accurate copy of a photograph of the perforated tube or strainer of Bigelow's improved evacuator, taken at the close of an operation at St. Luke's Hospital not long since, will, however, go far to justify Sir Henry's statement.

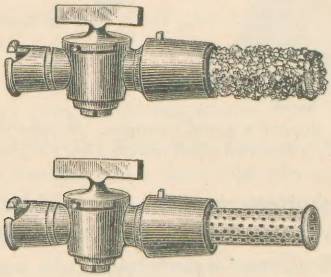

FIG. 2.—Clogging of the tube. The upper figure shows the obstructed tube; the lower one, the same after cleansing.

In cases free from mucus and pus and perfectly free from any admixture of blood with the water during operation, there will not be any noteworthy difficulty; but if there is a trace of blood present in the progress of the procedure the perforated tube will inevitably and promptly

become blocked, as in the photographic reproduction above presented. The instrument was a good one for practical purposes before the addition of the perforated tube; but it was open to the objection, as shown, that *débris* was likely to be left in the bladder after operations with it. Save under very favorable conditions or by the frequent cleansing during operation, the objection evidently remains.

Sir Henry Thompson's experiments and modifications finally culminated in an evacuator which, equally in action, prevented the return of *débris*, without being open to the objections made against Professor Bigelow's instrument. This improved aspirator was presented in the London "Lancet" of April 12, 1884.

"The improvement consists in a light, loosely hanging valve of fine wire attached by a simple hinge to the end of the evacuating tube, which terminates within the glass trap of the instrument. When pressure is made on the India-rubber globe, and the current flows by the evacuating catheter into the bladder, this light valve is driven close to the aperture and no *débris* can leave the glass trap. When the pressure is removed and the current returns from the bladder, the valve floats widely open and permits the *débris* to enter unchecked. The wire valve is circular in form, and its border, being flat and thin and about the tenth of an inch wide, is delicately sensitive to the movements of the current, and responds to the slightest impulse of the hand on the India-rubber globe." "But," Sir Henry further remarks, "I am quite satisfied that, with my last published aspirator (the one so elaborately criticised by Professor Bigelow in the 'Lancet' of January 6, 1883), as well as with the form now described, no *débris* returns to the bladder if the instrument is properly used, when, of course, the valve is unnecessary. Few persons are aware that very

slight but quickly made pressure on the globe, sufficing to transmit only six or eight drachms of fluid into the bladder,

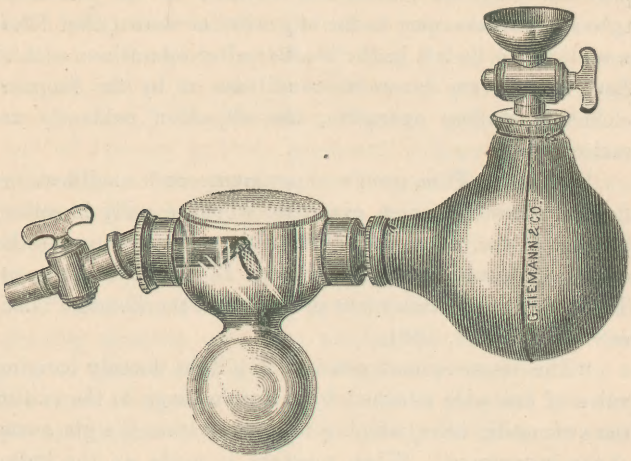

FIG. 3.—Sir Henry Thompson's instrument (improved, 1889).* Holds 12½ oz.; weighs 27½ oz. (Troy) empty ; 40 oz. filled.

generally removes more *débris* than a powerful impulse which transmits, at one act, all the fluid contents of the globe, or nearly so. When employed in the manner last named the valve becomes useful, and only then is it required."

At the commencement of the evacuator contest I was using very satisfactorily the original Bigelow instrument, and was, at the time of the notable discussion in the London International Congress of 1881, under the impression that it was the best then in use. During that discussion Sir

* This cut, which shows the swinging trap of Sir Henry Thompson's instrument, is taken from the latest modification (1889), wherein the general form of the instrument approaches more nearly to that of the author (see Fig. 1).

Henry Thompson accorded to me a fair share of the honor of contributing something toward the ultimate success of the operation of removal of vesical calculi at a single sitting. My distinguished countryman, Professor Bigelow, however, neglected to give me the credit of the previous discovery of the normal urethral caliber, through which alone the rapid evacuation became possible. Not desiring to assert my claim as a grievance, I determined, if possible, to invent another evacuator and, in describing it, to write the history of evacuators in general; in this I proposed, while according honor where honor was due, to take what I believed to be my legitimate place in the preliminary history of litholapaxy.

Two years after—viz., in November, 1883—I presented and demonstrated my first evacuator at a meeting of the New York Academy of Medicine, and read a paper in which "the removal of *débris* from the bladder after lithotrity"* was fully considered, with representations of previous instruments which had been in use for that purpose, adding those of my own, and in which, while it was distinctly shown that Professor Bigelow did not discover the increased capacity of the urethra, which alone made his operation possible, and also that he did not discover the tolerance of the bladder to prolonged instrumental interference; yet, as I there maintained, "he did much more—he utilized the knowledge which he, in common with other surgeons, possessed. He had the inspiration to conceive of its value as a factor in a great life-saving operation. He seized my demonstration of an average urethral caliber of 32 mm. in circumference. He joined it with his knowledge of the tol-

* Subsequently published in the "Medical Record," and in a reprint (1883) entitled "The Simplified Evacuator for the Removal of Débris from the Bladder, after Lithotrity." New York: G. P. Putnam's Sons.

eration of the bladder to legitimate surgical procedures, and litholapaxy was born. He had the courage, the surgical knowledge, the skill, the inventive mechanical genius, and the perseverance to carry it, *vi et armis*, to a successful maturity, thus finally achieving one of the most brilliant surgical triumphs of modern times."

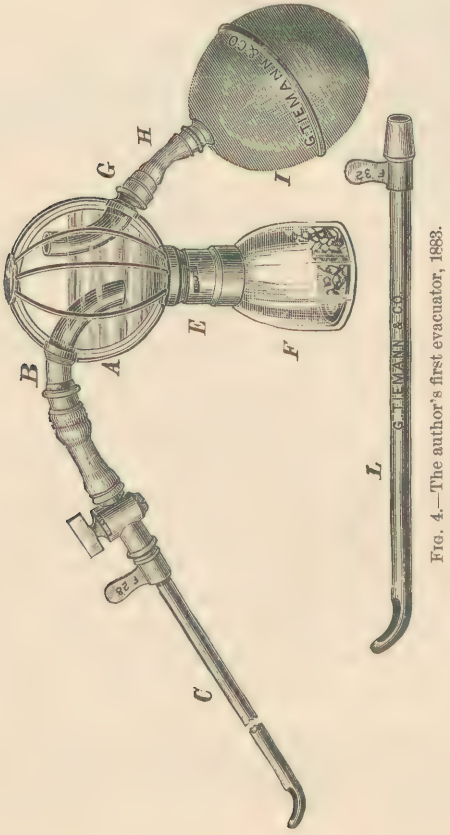

FIG. 4.—The author's first evacuator, 1883.

My own instrument was constructed on an entirely different plan from those of both Professor Bigelow and Sir Henry Thompson. Having appreciated the difficulties of overcoming the alleged faults of both, I endeavored to accomplish evacuation without return of the *débris*, independently of traps, valves, or strainers. This was effected by a simple breaking of the currents to and from the bladder, so that the *débris* should be released *in transitu* and drop down into a receiver arranged to be a perfectly dead point.

In its practical working it was found fully equal in its evacuating power to the improved instrument of Bigelow, with the advantage that, without trap or strainer, no *débris* was returned to the bladder. It was found, however, that, under circumstances where, during the operation, it became desirable to introduce an additional amount of water into the bladder, this could only be effected with considerable inconvenience—much greater than in Bigelow's or Thompson's instruments. In 1885, therefore, a tap and stop-cock were added at the end of the rubber bulb, as shown in Fig. 4, so that, when it was found desirable to introduce additional water into the bladder, this was done with great ease by attaching the discharge-pipe of the Davidson syringe to a stop-cock (at L), while the supply end is immersed in a vessel (preferably a large glass graduate) filled with water at a proper temperature. The easy attachment and detachment of the Davidson syringe allow any desired amount of fluid to be introduced into the bladder without delay or inconvenience. With this addition the instrument did most satisfactory service in my hands during the following two years. The only real embarrassment which was found in the use of this evacuator was from the weight and inconvenience of manipulation of the two stop-cocks, which objection obtained equally in the instruments of Sir Henry

Thompson and Professor Bigelow. At the suggestion of my son, Dr. William K. Otis, who had noticed the greater lightness of the evacuator of Dr. Ultzmann, of Vienna, I

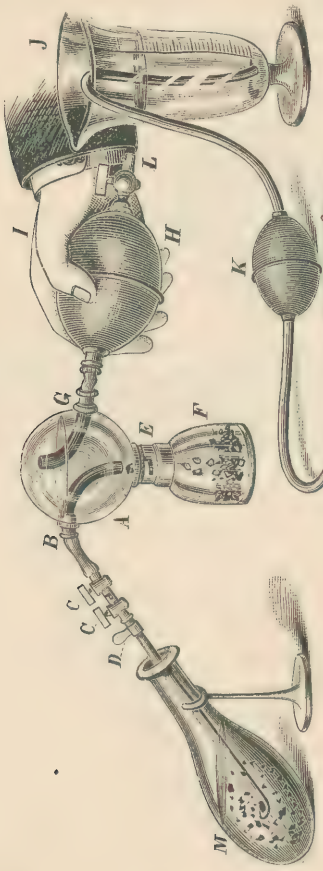

FIG. 5.—The Otis evacuator. With Davidson syringe and graduate.

substituted hard-rubber fittings similar to his, and, in the course of experimentation which this change suggested, re-

moval of all intermediate connections between the glass reservoir, the rubber bulb, and the evacuating catheter, was found practicable, decreasing the weight and adding to the ease in handling the instrument. It was then discovered also that a stop-cock was not necessary to prevent the water from flowing from the evacuator, this being effected by atmospheric pressure alone in any position which the handling of the instrument required, and that only when laying it down was any water liable to run out. For use in this event, a simple plug of hard rubber, attached by a string, was alone necessary.

The successful elimination of one stop-cock, previously supposed to be the most important and still absolutely essential in the instruments of both Bigelow and Thompson, directed attention to the possibility of getting rid of the remaining stop-cock on the evacuating tube, which seemed desirable in order to prevent loss of water while attaching the evacuator to it after the crushing. It was ascertained in actual practice that, by changing the routine of operation a little, this stop-cock was also wholly unnecessary. These important changes decreased the weight to such an extent that, when filled, my perfected evacuator weighed six ounces less than Professor Bigelow's empty. Now, instead of attaching the evacuator to the evacuating tube immediately upon its introduction into the bladder after crushing, the fluid was allowed to flow out, carrying with it all the fragments that could thus be washed out; then, deliberately attaching the evacuator to the tube, the desired amount of water for working the instrument easily was introduced by means of the Davidson syringe, which was connected with the rubber bulb. The syringe was then attached, and the evacuation deliberately proceeded with. It was not found necessary to press the end of the evacuating tube to the extent of depressing the bladder floor, so as to

make the portion with which it is in contact the lowest point, as advised in using the evacuator of Professor Bigelow; but the current was sufficiently strong to draw out the *débris*, if the tube was simply well introduced into the bladder cavity.

Among the tests which were originally made to prove that the receiver was a perfectly dead point, and that fragments once deposited in it were thus entirely out of the influence of the currents passing to and fro during evacuation, was that of filling my evacuator completely as for ordinary use, then detaching the reservoir, emptying it, refilling it with glycerin, and then reconnecting it with the reservoir. A small quantity of crushed coral (which more nearly resembles vesical calculus than coal) was introduced into an ordinary soda-water bottle, and this half filled with water, to which a little ink had been added. On working the bulb, the fluid thus colored was seen to pass back and forth through the reservoir, but not in the least mixing with the glycerin, while the coral was drawn out of the bladder in the inky current, and, receiving its impulse and direction from the discharge-pipe, was disengaged from the colored medium, and, dropping down through the clear glycerin, was deposited at the bottom of the receiver. This experiment, which proved in a striking manner the perfect retention of the *débris* in the receiver during evacuation, was subsequently found to work admirably in actual practice; and in all operations, for the last two years, where blood was present in sufficient quantity to obscure the fluid, I have used the glycerin with great satisfaction. Without it, it will occasionally be difficult, and sometimes impossible, to tell whether the evacuation of the *débris* is proceeding satisfactorily without disengaging and emptying the receiver.

The changes which have been made in the old instrument are as follows:

1. Removal of all stop-cocks.

2. Removal of tubing between bulb and globe and between globe and evacuating tube, thus making the instru-

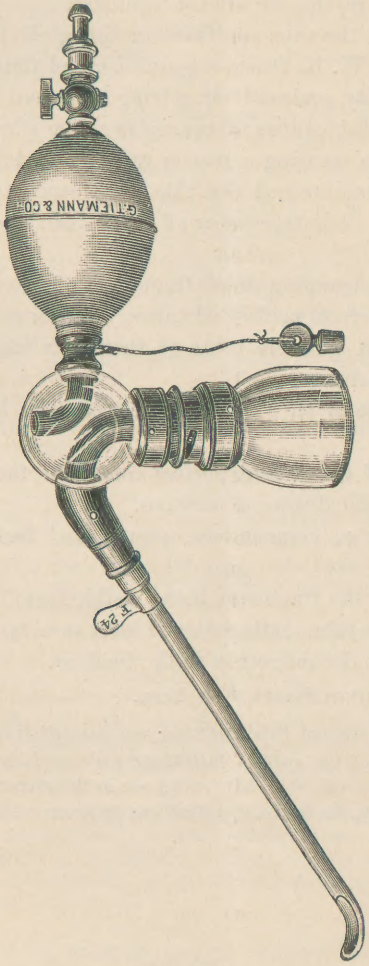

Fig. 6.—The perfected Otis evacuator. Holds eight ounces; weighs ten ounces empty; eighteen ounces filled.

ment more compact, and the distance from the bladder to the receiver the shortest possible.

3. Introduction of hard rubber in place of metal wherever possible, giving the utmost lightness.

4. Making the tube apertures in the globe oval instead of round (Dr. W. K. Otis's suggestion), and thus giving the greatest security against their getting loose and leaking.

5. Increasing caliber of evacuating tube where it enters the globe, thus securing a greater rapidity in delivery.

It is now maintained that this latest evacuator presents the following advantages over all other instruments now in use:

1. Perfect trapping of all fragments without the use of any form of valves, perforated tubes, or strainers.

2. Shortest possible route of fragments from the bladder to the receiver.

3. Absence of all stop-cocks between the bladder and receiver.

4. Ease of filling and perfect control of the amount of water in bladder during evacuation.

5. Lightness, compactness, power, and facility of manipulation.

6. In that the fragments being visible from the moment of leaving the tube until removed from receiver, it can be seen that they do not return to the bladder.

5 West Fiftieth Street, New York.

Note.—The original Otis evacuator was manufactured by Messrs. George Tiemann & Co., surgical instrument makers of New York, who, with much pains and skill, have aided me in the succeeding changes necessary to bring the instrument finally to its present state of perfection. F. N. O.

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